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ABSTRACT

Discoveries about the acquisition of American Sign Language (ASL) by deaf children are reviewed. Current research shows that ASL has developed as a fully autonomous language with complex organizational properties not derived from spoken language. Like spoken languages, ASL exhibits formal structuring at two levels and similar organizational principles, but its grammatical structuring assumes a form deeply rooted in the modality of the language. Sign languages are strongly representational, yet fully grammaticized. They exhibit layered rather than linear organization and make structured use of space and movement, nesting the basic sign in spatial patterns and complex dynamic contours of movement. In order to explore the existence of modality effects in acquisition, the acquisition of three morphological subsystems among young deaf children is examined: the transition from gesture to sign, the spatial marking for verb agreement, and the formal distinction between nouns and verbs. It is concluded that children develop signed or spoken language in a similar manner. Language, independent of its transmission mechanism, develops in a rapid, patterned, and linguistically driven way. Illustrations of child and adult sign language and a bibliography are provided. (RW)

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The Acquisition of Three Morphological Systems in American Sign Language*

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I. Introduction

To suggest such a title would have been impossible as little as ten years ago, when there was yet no evidence of a highly structured morphology in signed languages. However, the explosion of research on the structural properties of signed languages has made clear that these forms of gesturing have been forged into complex linguistic systems in the hands of deaf people across a few generations. Interesting that this should be so, given that deaf people do not form a geographic community (although, of course, the schools for the deaf provide an opportunity for interchange), and given that the forms found in the language still bear such striking clues of their origins in the representation, in the hands, of shapes, objects, actions, and events. When we began our studies in 1970 we maintained a listing of all the available manuscripts and papers on sign language studies, since they were so scattered, so few in number, and tended to be buried in out of the way publications. In 1982, we find we can no longer keep up with the books and dissertations which are blossoming forth from different parts of the country, let alone with the new studies of signed languages in different parts of the world. We shall first examine briefly some of the ways in which signed and spoken languages are similar and some of the ways in which they differ. The new understanding of sign language grammar has led to some important discoveries about the acquisition of language by young deaf signers.

A. Modality and Language

Current research shows that American Sign Language (ASL) has developed as a fully autonomous language with complex organizational properties not derived from spoken languages, thus providing a new perspective on human languages and on the determinants of language organization (Baker and Cokely, 1980; Bellugi and Studdert-Kennedy, 1980; Klima and Bellugi, 1979; Lane and Grosjean, 1980; Siple, 1978; Wilbur, 1979). Like spoken languages, ASL exhibits formal structuring at the same two levels (the internal structure of the lexical units and the grammatical scaffolding underlying sentences); it also reveals similar kinds of organizational principles (constrained systems of

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features, rules based on underlying forms, recursive grammatical processes). Yet the form this grammatical structuring assumes in a visual-gestural language is apparently deeply rooted in the modality in which the language developed.

Despite the commonalities in principles of organization between signed and spoken languages, there are aspects of linguistic form in signed languages that stand out as most strongly resulting from the difference in modality. These differences are not necessitated by the modality difference, but are at least seductively invited by it. A fundamental difference between ASL and spoken languages is the iconicity that pervades the language at all levels. Characteristically, lexical items themselves tend to be globally iconic, their form resembling some aspect of what they denote. At the morphological and syntactic levels also, there is often congruence between form and meaning. Spoken languages are not without such direct clues to meaning (reduplication processes and ideophones provide direct methods of reflecting meaning through form, for example). But in sign language such transparency is pervasive. ASL thus bears striking traces of its representational origins, but at the same time is fully grammaticized. Another difference is in surface organization: signed languages display a marked preference for layered (as opposed to linear) organization. The inflectional and derivational devices of ASL, for example, make structured use of space and movement, nesting the basic sign stem in spatial patterns and complex dynamic contours of movement. In the lexical items, the morphological processes, the syntax and the discourse structure of ASL, the multi-layering of linguistic elements is a pervasive structural characteristic (Bellugi, 1980). While ASL is the most thoroughly analyzed of the signed languages of the world to date, other signed languages that have been so far examined suggest that these are general characteristics of primary signed languages.

One might have every reason to believe that such surface differences between signed and spoken languages might influence the course of language acquisition. If the mapping between meaning and form is more direct than in spoken language, then this might allow the child a more direct route into the language at all levels. The change in transmission system (from the ear to the eye, from the vocal apparatus to the hands) might in itself be expected to influence the course of acquisition. For example, in signed language, unlike spoken language, the articulators are visible and manipulable. This provides an opportunity for certain mother-to-child interaction that is not available for spoken language. In this paper we examine the extent to which such surface differences affect the acquisition of sign language by deaf children of deaf parents. Before presenting some of the first findings of our acquisition studies we shall take a brief look at the structure of the language as it is reflected in its morphology.

B. Three Dimensional Morphology

Signs of American Sign Language are related by virtue of a wide variety of inflectional and derivational processes. Different base lexical forms have families of associated forms, all interrelated by strictly formal patterning, based on modifications of the movement of the signs in space. Thus a single root form, for example that glossed as ASK or QUESTION[1], has a wide variety of manifestations, as shown in Figures 1 and 2. These different forms mark grammatical categories such as person, number, reciprocity, temporal aspect, distributional aspect on the verb, as well as form the basis for noun-verb derivationally related pairs and a host of other derivational processes. What defines ASL as an autonomous language is that its specific morphological markings do not match those of English in any way. In fact the inflectional devices are far more differentiated than those of English. The variety of inflectional and derivational devices indicate that ASL is an inflective language, more like Hebrew, Latin, and certain African languages than like English or Chinese. (Bellugi and Klima, 1979; Klima and Bellugi, 1979).

-----Figures 1 and 2 here-----

In the kinds of distinctions that are morphologically marked, ASL is like many spoken languages; in the degree to which morphological marking is a favored form of patterning in the language, ASL is again similar to some spoken languages. However, in the form by which its lexical items are systematically modified, ASL may have aspects that are unique. In a Semitic language like Hebrew, words are composed of tri-consonantal roots, with vowel patterning interwoven. These roots form the basis for a wide variety of distinct inflectional and derivational patterns. For example, k-t-v is considered to be the basis for such words as katav, 'write'; ktiv, 'spelling'; katuv, 'written'; hitkatev, 'correspond,' and so forth (Berman, 1978). It has been argued that these are appropriately analyzed as multi-tiered structures; the root, as one skeleton tier and inflectional and derivational morphemes each as a separate tier (McCarthy, 1979). But the final surface form of Hebrew lexical items no longer reflects its layered structure: ktiv differs from katav and katuv in the temporal arrangements of its sounds, represented as consonants and interleaved vowels. In ASL, which is similarly morphologically rich, families of sign forms are related by an underlying root: in the case of the forms in Figures 1 and 2, what is shared by all is a handshape /G/, a location (plane in front of body) and a movement shape (closing of finger). Inflectional and derivational processes represent the interaction of this root with other features of movement in space (dynamics of movement, manner of movement, directions of movement, spatial array, doubling of the hands, reduplication, and the like), all layered, as it were, on the sign root. (Note that morphological patterns themselves are often congruent with their meanings.) This generates a wide variety of forms, e.g. 'ask you,' 'ask each other,' 'ask all over, 'ask them,' 'ask each of them,' 'ask continuously,'

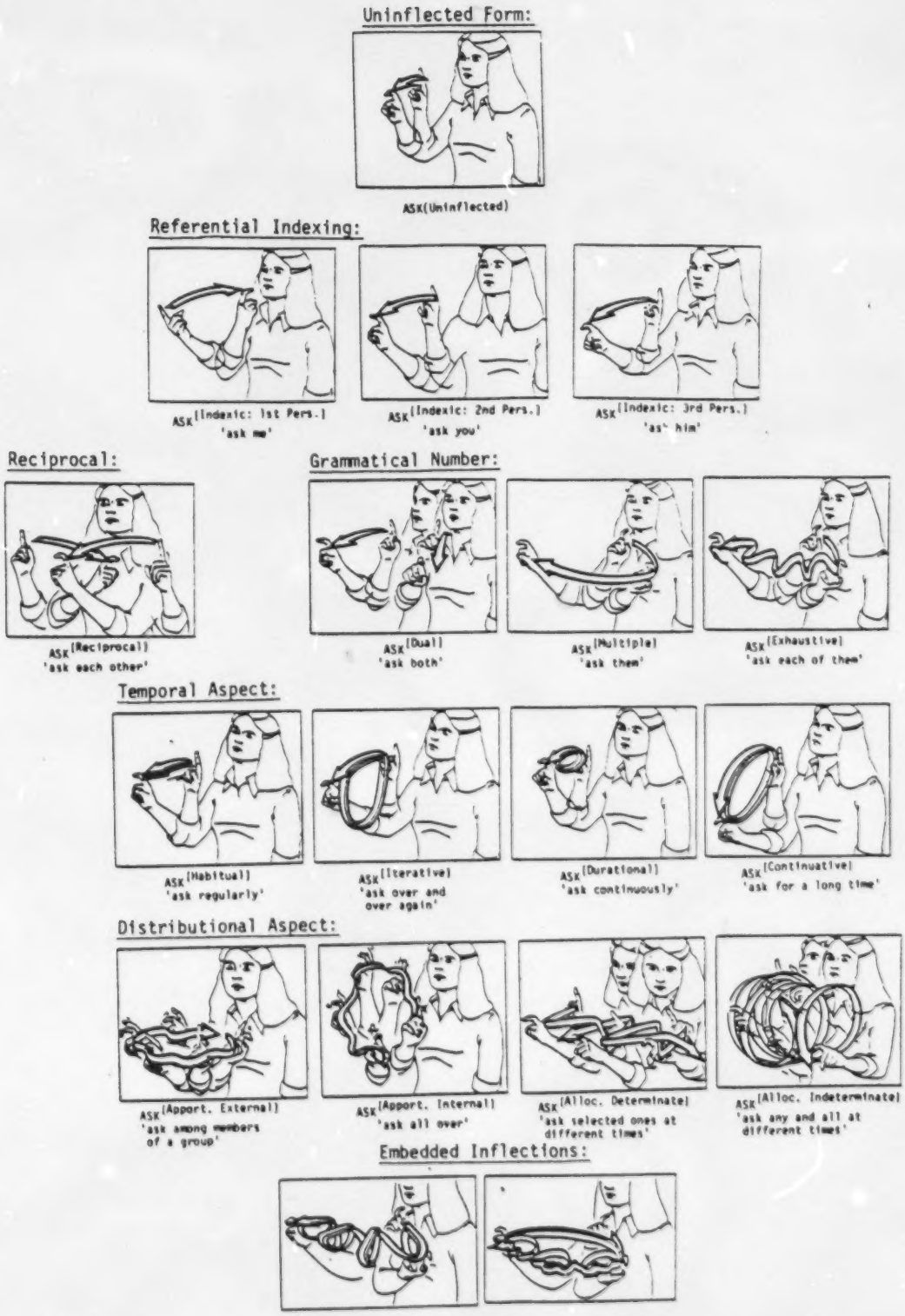


Figure 1 Inflectional Operations on a Single Root: ASK

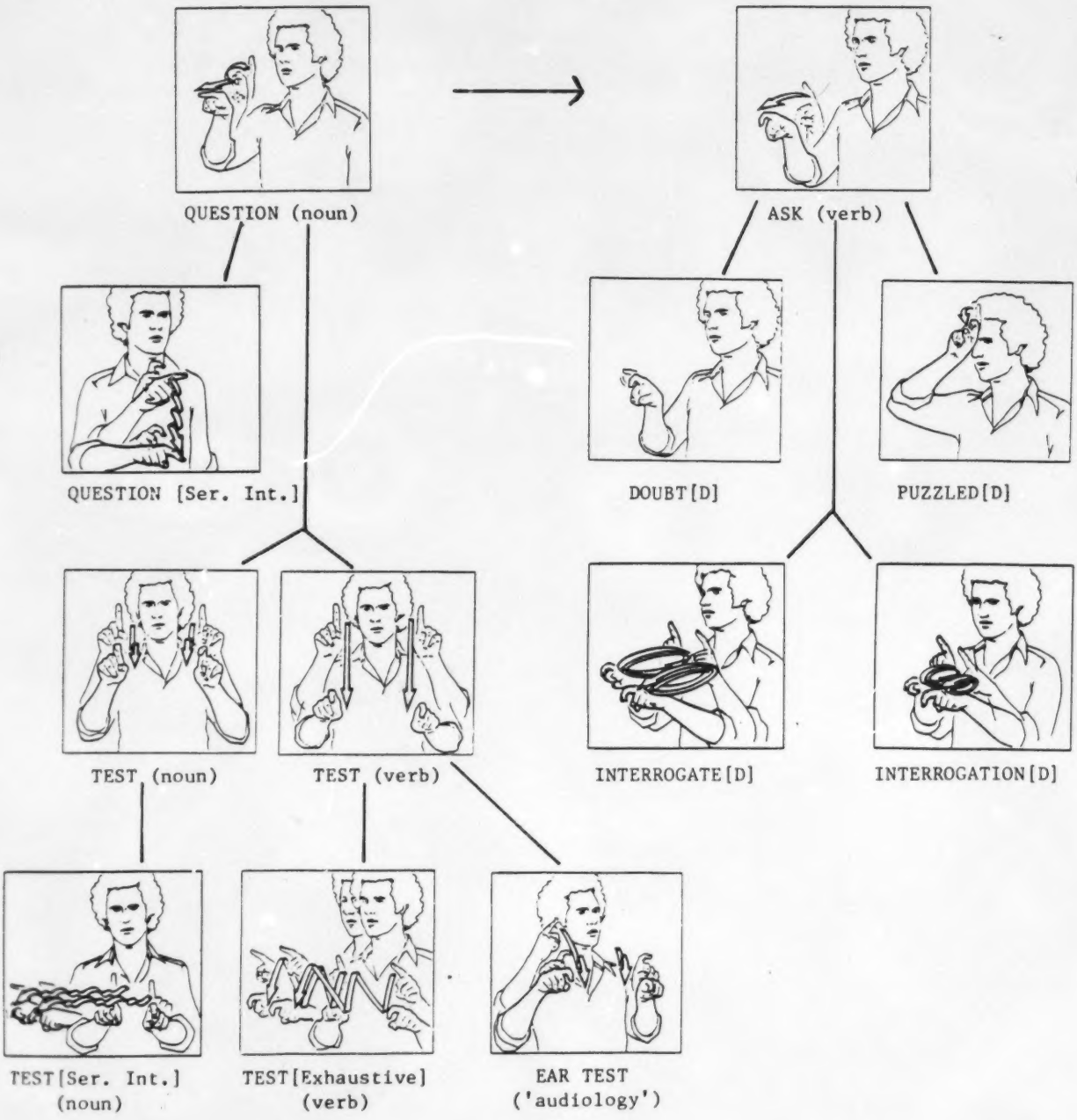


Figure 2. ASK/QUESTION and Some Related Forms

'ask regularly,' 'doubt,' 'test,' 'question,' 'interrogate,' 'interrogation,' 'inquire,' and many more. Unlike the examples from Hebrew, the surface forms of ASL inflectional and derivational patterns retain their tiered structure in the final output.[2] And yet the regularities that relate root and morphologically complex forms--the formal rules--are similar in the two types of languages.

We have chosen three subsystems that seemed to us to be the best candidates for showing modality effects in acquisition--the transition from gesture to symbol in pronominal signs; the spatial marking for verb agreement; and the formal distinction between nouns and related verbs.

II. The Acquisition of Three Subsystems

A. The Transition from Gesture to Sign

The system of person deixis in ASL gives rise to a particularly striking issue in the connection between transparency and grammatical system in the acquisition of language. Deixis in spoken languages is considered a verbal surrogate for pointing; in ASL, instead, it is pointing. The grammatical category of person is defined with respect to participant roles in discourse. First person is used by speaker to refer to himself; in ASL, the signer points to his own torso; second person refers to addressee, and in ASL it is realized by pointing toward the torso of the addressee. These pronominal signs in ASL are, in fact, the same as the pointing gestures that hearing people sometimes use to supplement their words nonverbally. We may say, "I mean you" while pointing at a specific person to single him out. What is paralinguistic with respect to a spoken language then, is a lexical item within the context of this fully developed gestural language. It is in fact part of the indexical system involved with verb agreement. If these so-called "pronouns" are really just pointing, this should make the use, understanding, and acquisition of these forms very straightforward and cause them to appear early and error-free in young deaf children of deaf parents.

The problems that young hearing children have with the acquisition of such terms as I and you in spoken languages like English are well known, and have been documented. Such deictic terms all involve shifting reference, which is very different from names or nouns. Having agreed to call one person Jane or Mother, each speaker uses the same name. But with terms like I and you, the term does not apply to the person, but rather with a person's turn as speaker or as addressee. These "shifters" as Jakobson (1957) called them, present problems for young children learning spoken languages. Eve Clark (1978) suggests that children begin by using first person forms, and do so only sporadically at first, often in alternation with the child's own name; problems may arise when children begin to use the contrasting form, you. Clark posits that some children form the

hypothesis that the I used by an adult speaker is an alternative to that person's name; and that the use of you is in reference to themselves. Clark cites examples of such observations from a number of different studies and in a variety of languages. Several other studies recently have focused on this issue (Chiat, 1981, 1982; Charney, 1980; Deutsch and Pechmann, 1978). The child's "incorrect hypothesis" is generally corrected within a few months. By the age of 2;6 to 3;0, most hearing children have mastered such shifting pronominal terms.[3]

We had fully expected that the learning of the equivalent of pronominal reference in ASL would be easy and early ("trivial" is the way we expressed it). The hearing child's problems with the shifting nature of such arbitrary strings of sounds such as you and me is readily understandable; there is no clue in the form of the sounds to the referents. But in ASL, the pronoun signs are exactly the same as pointing gestures; if I sign "YOU" and you sign "ME," we are both indicating (pointing to) the same person! With such obvious gestures, directness of reference would seem inescapable. When our early videotapes revealed that mothers tended to use names rather than pronoun signs with their children, and that the children did the same, and when parents told us that the child's misunderstandings of pronominal reference had motivated their switch to using name signs, we were very surprised. We had not, at that time, observed children unequivocably producing pronoun errors spontaneously. Frankly, we and other researchers could not imagine that deaf children would make mistakes in person reference by pointing. That is, not until we found the following exchange on one videotape of a deaf mother and her deaf child of 1;3 (see Figure 3a):

Mother: WHERE MOTHER?
'Where's Mother?'

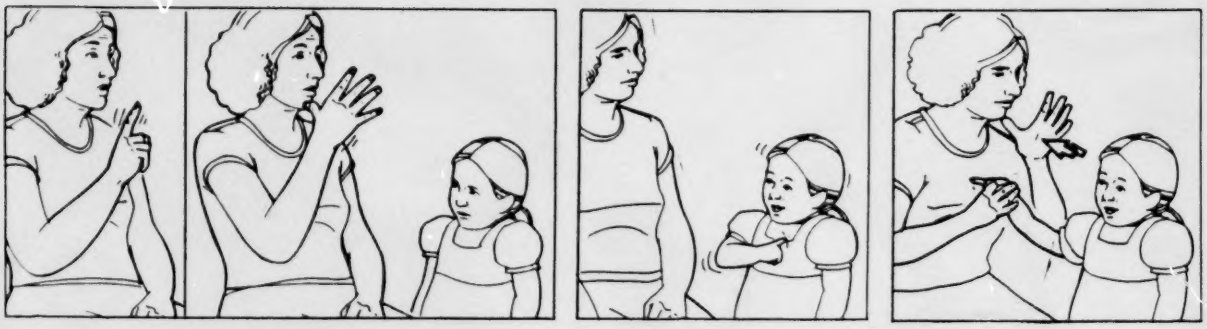
Child: ME! (pointing to herself).

Mother: (Mother looks surprised) NO!
ME MOTHER!
'Not you; I'm mother.'

The mother then took the child's hand, moved it so the child's arm was outstretched and made the child's hand point to the mother's chest, signing MOTHER with the other hand, for emphasis.

-----Figure 3 here-----

In our laboratory, Laura Petitto has now taken on a serious investigation of this fascinating area, and is embarked on a systematic study of the acquisition of pronominal reference in deaf signing children, combing through videotapes and setting up experimental and elicitation situations at critical ages. (Petitto,



a) WHERE MOTHER? ME! MOTHER ME

b) SWIMSUIT YOU

c) MOTHER ME

Figure 3. Child's Incorrect Pointing Signs (a and b); Child Imitating Signs (c).

1980, 1982). It turns out, to our surprise, that for the signing child, this is not an error-free area at all; quite the contrary.

Petitto's involvement with this area came about in a natural way. One day, a deaf mother and her child (age 1;11) from our acquisition study came to visit the laboratory. We asked the mother (who had formerly been a researcher with us) whether the child ever made mistakes in pronominal reference. 'No,' signed, the mother, 'I don't think so.' But at that point, Petitto noticed the charming toddler pick up her own tiny red bathing suit that she had chosen, hold it up to herself, and sign "SWIMSUIT YOU" (see Figure 3b). The mother, a trifle embarassed, signed, "NO, NO, NO. YOU MEAN YOU," making the pointing sign directly and forcibly on the child. This "correction" had no effect whatsoever; the child wandered around our laboratory blithely pointing incorrectly for reference to herself and others. In a language where the "speech organs" are directly visible and moreover, manipulable, this kind of mother-child correction can take a remarkably different form than it does in spoken language. On several occcasions, when the child reversed pronouns, the mother actually took the child's hand, turned it around, and moved it vigorously in the 'correct' direction. To no avail. On the next opportunity the child persisted in making errors.

What might lead the deaf child to overlook the simplicity of reference of the pointing gesture? One aspect may be that pointing signs in ASL share formal properties with other ASL signs: there is nothing in their form that singles them out as different. The sign glossed as "ME" is made with the index finger extended from a closed fist (configuration) with a contact (movement) on the torso (location). There are many ASL signs that share in just those properties: the same hand configuration occurs in the signs HOUR, CANDY, GO; the same location in FEEL, DRESS, ANIMAL; the same movement in FINE, VACATION, MOTHER. Thus no aspect of their formational properties would indicate their special status as deictic pointing signs. Figure 3c, for example, shows a deaf child imitating the signs MOTHER and ME. It might well be that the child in the early stages of acquiring signs assumes that the pointing sign ME is a formal name--perhaps an alternate name--just as is the sign MOTHER, and he might temporarily assume that they refer to the same person.

Petitto has now developed a series of tests for comprehension and production of pronouns for self and addressee, and is collecting data across young deaf children. What is striking in the data is that errors are evident in comprehension, and prevalent (as well as uncorrectable) in production. Petitto finds in a deaf child, the following distinct periods marking the transition from gesture to sign:

1) At ten months of age, the child points freely, using the extended index finger in a gesture which has essentially the same form

as the ASL sign used for first and second person reference and for other pronominal reference. The child's pointing serves a variety of functions: for investigating and indicating, for pointing to herself and others.

2) During the following year (10 months to 1;9), something very dramatic happens in her use of pointing--one aspect of her pointing completely drops out. While she continues pointing for investigating and for indicating objects, she no longer points to herself or to her addressee; apparently this is a transition stage. Hours of videotaped sessions during this period are completely devoid of this use of pointing that was richly represented earlier; however, the child does make reference to herself and others through lexical signs. During this same period, the child's language development is marked by a steady growth in the vocabulary of signs, stably used in a variety of contexts, and by the rise of multi-sign sentences.

3) Petitto found the first instance of a re-emergence of pointing toward addressee when the child was 1;10. The child was hungry, and apparently wanted something to eat. She signed "EAT, YOU WANT EAT." The mother responded in ASL, 'No, I don't want to eat. I'll eat later.' But then the child went to get the basket with her food in it; the mother, realizing the child's error, signed the ASL equivalent of 'Oh, you mean <u>you</u> want to eat.' Thus, after one year's absence there appears in an ASL sentence the first pointing sign directed toward the addressee; and it is a reversal: she points toward her mother to mean herself! The following month there was a surge in the occurrence of pointing signs for pronominal reference; and nearly all of them were incorrect. During this period the child appeared completely impervious to corrections by her mother--even to manipulative forms of correction as when the mother took the child's hand and twisted it around to point in the right direction. The consistency of these reversals and their resistance to correction lead Petitto to investigate the child's use of "I" and "YOU" in a systematic fashion.

4) Following the child over the course of the next few months, Petitto found that such pronoun reversals were resolved by 2;3. The linguistic system by then matched that of the adult language. She is now investigating this interesting phenomena across other young deaf signing children.

Thus there is dramatic evidence of the transition from gesture to sign, a transition marked by the presence of a form as a pointing gesture, to its absence over a period of several months, and then re-emergence of the same form as a pronominal sign, now integrated into a linguistic system, but marked by systematic reversals. As part of a linguistic system the form appears to present to the signing child exactly the same problem as do arbitrary shifting terms across the world's spoken languages. It appears to make little difference,

then, whether the pronominal terms are symbolized by arbitrary streams of sound segments as in spoken language, or by pointing signs which are indistinguishable in form from pointing gestures. Deaf children, just as do hearing children, appear to have problems acquiring systems that mark shifting reference and require adopting shifting perspectives.

Deaf children learning ASL are not late in this kind of development. The errors and their resolution occur exactly on target with those observed in children learning spoken languages, neither early nor late. Thus, the directness of the relation in form between a pointing gesture and a pronominal sign does not prevent the child from taking certain garden paths on the way to the acquisition of the language--garden paths well-attested in the literature on the acquisition of spoken languages.

Whatever may be the correct interpretation of the meaning of such reversed forms, their occurrence in these ASL learners suggests very strongly that the same strategies are being employed by deaf and by hearing children. Language-learning strategies prevail over whatever facilitative effect on the acquisition process may otherwise inhere in the motivatedness of linguistic form.

We have considered so far, only one aspect of learning American Sign Language, the pointing signs for first and second person which are part of the pronominal system in ASL. We now turn to another subsystem that involves spatial loci: the level of inflectional morphology by which verb signs are systematically modified to indicate grammatical categories such as agreement for person and number.

B. The Spatial Marking for Verb Agreement

Many spoken languages have verb agreement systems, whereby the form of the verb reflects certain grammatical categories of its arguments. For instance, in Latin, the verb varies in form (amo, amas, amat) depending upon person and number of its subject. In ASL, there is also a system of verb agreement. Like the pronominal reference system in ASL, it is essentially spatialized: both utilize referential points in space as one of their morphological components. Verbs are thus not frozen immutable forms, but undergo regular inflectional variation to mark person and number of their arguments. In function, this system operates like verb agreement in spoken languages. However, in its form--marking connections between spatial points--verb agreement in ASL bears the imprint of the mode in which the language evolved. We shall first describe some aspects of verb agreement that have an iconic basis and thus might provide a different point of entry for the signing child; then we describe aspects of the adult agreement system, and the steps by which the child masters the system.

The members of a large class of ASL verbs obligatorily "agree with" (or index) the locations of either one or two noun arguments. Such locations can be points in the signing space corresponding either to the location of the referent of an argument of a verb, or to an abstract location in space which the signer has established for the argument. Verb agreement in ASL has been described as pantomime in some earlier writings, and it is clear why it was so considered. When the addressee is the subject of the verb and the speaker is the object, the verb sign moves from a point corresponding to the location of the addressee to a point near the speaker; when the roles are reversed, the direction of movement of the verb is reversed. Thus the ASL sign equivalent of 'I give you' is the verb GIVE moving from speaker toward addressee (GIVE[X:1 to 2]). Since the image base of the sign GIVE is transfering an object by hand, this inflected sign form has much in common with the mimed act. For 'you give me' the sign form moves from addressee to speaker (GIVE[X:2 to 1]). The iconicity of such an agreeing verb form is certainly direct, presenting a spatial analogue of the movement of the transferred object. The deaf child, on seeing mimetic forms such as the ASL equivalent of "I give you," "I give him," "you give me," might sieze on this direct representation of sign forms to modulate the meanings of his signs, and the influence of such iconicity could very easily appear in the child's early signing.

Within the verb system in ASL there are several classes of verbs that behave differently with respect to agreement. Not all verbs mark agreement; of those that do, not all are marked in the same way. Among verbs that do not inflect for the loci of their arguments are SPELL, SAY, and LIKE. Some verbs have obligatory agreement (e.g., GIVE, TAKE, TELL); some optionally undergo agreement (SEE, SIT, BREAK); some can agree with only a single argument (WANT and SEE); some may agree with the spatial loci of two arguments (GIVE and LOOK-AT). Verbs also differ with respect to which argument is marked. However, the general mechanism for agreement on verbs is the same for all those that are indexible: movement between spatial loci established for noun arguments, either in accordance with loci for present referents or with abstract loci associated with nominals in the discourse (Fischer and Gough, 1978; Padden, 1979, 1981, 1982; Klima and Bellugi, 1979).

How do children acquire a morphological system which is grammaticized, but which nevertheless displays a large amount of iconicity? Does the iconicity of ASL signs or grammatical processes give children a special way into language learning? Does iconicity have a pronounced facilitative effect on the mastery of the verb agreement system? Since the origins of such processes are so obviously direct, the child might well begin via the mimetic basis of signs or inflectional processes.

Recently, Richard Meier (1981, 1982) in our laboratory, has

examined the role of iconicity in the acquisition of verb agreement. If the iconic properties of ASL signs are accessible to two- and three-year old first-language learners, the iconicity of agreeing verbs should be highly accessible. The effects of such iconicity could be expected to appear in the acquisition of verb agreement. Meier develops three models which make specific predictions about what agreeing forms the children will acquire early and what error types they will produce. Two of the models make predictions based on iconicity: the first based on the relative similarities of agreement forms to mimed gestures; the second based on their relation to an analogic use of space with verbs of movement and transference. The third model makes predictions based on morphological complexity--a model which has been found to predict the course of the acquisition of inflectional systems in spoken language (Slobin, in press; Slobin and Aksu, 1980). Meier's analysis of the acquisition of verb agreement across three deaf children of deaf parents[4] ranging in age from 1;6 to 3;9 (coupled with an experimental study of a group of such children) reveals that verb agreement is acquired by children within a narrow age range. In one child, for example, verb agreement begins at 2;0 and is complete by 3;0; at that point the child is consistently providing correctly agreeing verbs across samples. We describe two periods in the children's acquisition of their first inflection:

1) Signing children around age two do not make use of the inflectional apparatus of ASL--including verb agreement--during the two and three sign stage. (The same phenomenon has been observed by Fischer, 1973, Newport and Ashbrook, 1977, and Hoffmeister, 1978.) Even when young children imitate prodigiously, their imitations tend not to preserve featural markings of the morphologically complex forms of parental utterances. For conveying something as direct as "you give me," two-year-old children instead sign the verb GIVE in its uninflected form which resembles the mimed act of its opposite--"I give you!" and sometimes add the separate pronoun sign, e.g. ME. Children use uninflected forms in contexts where the agreeing form is required with a variety of verbs (e.g.,PUT, TELL, LOOK, SHOW, GIVE, LEAVE, TAKE). In one instance, the child signed GIVE[X:1 to 2] toward her mother, clearly intending 'give me.' The mother signed "NO" and pushed the child's hands back toward her in an effort to mold the correct form! Thus, the signing child first uses uninflected forms, even in contexts where agreement is clearly required. The child does not enter the agreement system by exploiting the mimetic potential available within a visual-gestural language; he also fails to provide the grammatical markers required in the adult language.

2) Between the ages of two and three, the deaf children in our study begin to produce various inflected forms of the verb (dual and aspectual inflections) but first and most consistently, the forms showing verb agreement in contexts in which the referent is present. By around three, across deaf children, verb agreement is mastered in required contexts, and consistently used. The forms that children use

and the errors that they make en route to mastering the system support a morphological model of acquisition, rather than either an iconic model based on mimed actions or one based on an analogy with spatial displacement. For example, Meier finds that it is the morphologically more complex double agreement forms (even those that are more transparent mimetically) that are slower to be mastered.

We have observed a variety of overgeneralizations, as the children begin producing inflected forms in earnest. Children provide agreeing forms for verbs which are not indexible in the adult language, such as SPELL, SAY, and LIKE, among others (see Figure 4a). These forms are not mimetic or spatial analogic. The child inflects the verb SPELL for object (*SPELL[X:2 to 1], meaning 'spell to me'), although SPELL is not an agreeing verb. The child intending to sign 'I say to you' inflects *SAY[X:1 to 2], which is not permitted in the adult language. The verb LIKE is overmarked for object--*LIKE[X:1 to 3_i]--for the meaning 'I like that'. Furthermore children extend verbs like DRINK and EAT to agree with the subject, when in fact these verbs are not indexible in the verb agreement system. Thus, deaf children, as they are working out the system for indexing verbs, overgeneralize to non-indexible verbs in a way that is quite analogous to English-speaking children's provision of goed and holded for past tense. These sorts of errors can be explained in the most straightfoward way by a morphological model.

-----Figure 4 here-----

During this period, there are also errors in which the movement of the verb form is toward the wrong argument. For example, children inflect the verb GIVE toward the object to be given (e.g. *GIVE[X:to plate] HIM), for the intended meaning of 'Give the plate to him,' instead of toward the recipient (GIVE[X:'to him']). These forms are both ungrammatical and counter-iconic but they are, nonetheless, consistent with a morphological model; it is one of the grammatical arguments of the verb that is being marked but simply the wrong argument.

Thus the weight of the evidence is entirely consistent with early morphological analysis on the part of the signing child, and fits best with a morphological (not a mimetic or iconic) model of the acquisition process. The child does not make use of the iconic potential provided by the visual-spatial mode to enter the grammatical system. Rather, he begins with uninflected signs, and then systematically analyzes the morphologically complex forms, as well as analyzing which verbs do and do not undergo agreement, what arguments are marked, and whether the markers are optional or obligatory, etc. All of these aspects are worked out by signing children around the age of three; by then the ASL system for marking verb agreement is stabilized and mastered. In the acquisition of a grammatical subsystem of ASL in which one could expect a profound influence of

*SPELL[X:'to me'] / SPELL

*SAY[X:'to you'] / SAY

*LIKE[X:'to it'] / LIKE

a) Over-regularizations of Object-Marking on Verbs

*DUCK[N:dual] / DUCK

*BED[N:dual] / BED

*FUN[N:dual] / FUN

b) Over-regularizations of Dual

Figure 4. Children's Over-regularizations.

iconicity, we find that iconicity has no facilitating effect.

However, the question of the mapping between meaning and form in sign language and its role in the acquisition process is by no means fully resolved at this point. (See discussions by Brown, 1980; Schwam, 1980; Launer, 1982; Meier, 1981, 1982; Newport and Supalla, 1980, Slobin, 1980, for a range of views.) Other issues with respect to acquisition and transparency of morphological and syntactic form remain to be addressed. We are now studying the acquisition of other inflectional processes across the children in our study. The next inflectional form to appear in children's signing after the marker for verb agreement is a dual inflection on verbs. In one of its forms, the dual is marked by a simultaneous doubling of the hands; certainly a direct and vivid expression of duality. This morphological marker--doubling of the hands--occurs in the grammar of ASL in a variety of inflectional forms other than in the dual inflection: reciprocal has the two hands directed toward each other; characteristic aspect has two hands in alternating circles; distributional aspect has two hands directed to alternating nonseriated points. The semantic effect of these various forms which involve doubling of the hands ranges from 'to each other' to 'prone to' to 'action distributed across time'; there is no simple semantic common denominator (Klima and Bellugi, 1979).

As deaf children begin to provide the dual inflection in contexts that require it, they overgeneralize in interesting ways. For example, they do not limit the dual marker to verbs; but sometimes overextend it to mark nouns and other categories as well, using two hands to indicate duality. They sign *DUCK[N:Dual] to indicate two ducks, or *BED[N:Dual] to indicate two beds, and even *FUN[N:Dual] to indicate 'two people having fun' (see Figure 4b). These child errors are decidedly not options in the adult language: they are simply ungrammatical. One might consider that the child at this stage may be assigning some kind of transparent (admittedly iconic) semantic function (twoness) to a grammatical marker in the language (doubling of the hands) and overusing it for a brief period. We are pursuing these questions in further research.

C. The Formal Distinction Between Nouns and Verbs

ASL not only has a rich variety of inflectional markings, it also has a wide array of derivational processes, all of which are marked by movement distinctions in the language. There are derivational processes that form deverbal nouns (a form meaning 'comparison' from the verb COMPARE); derivation of predicates from nouns (a form meaning 'business-like' and a different one meaning 'proper' from the sign BUSINESS); nominalizations from verbs (a form meaning 'the activity of measuring' from MEASURE); sentence adverbials from basic signs (a form meaning 'instead' from DIGRESS); characteristic predicates from verbs (a form meaning 'vain' from PRETTY); as well as derivations for

extended or figurative meaning (a form meaning 'horny' from HUNGRY), and so forth.

Recognition of the derivational processes in ASL dates back only to about 1978 or so, when these processes were first described (Supalla and Newport, 1978; Klima and Bellugi, 1979). Before that time, analysts and signers alike thought that there were no principled ways to distinguish, say, a noun from a verb form, or nouns and verbs from any other form class. In fact, the ground-breaking Dictionary of American Sign Language (Stokoe, Casterline, and Croneberg, 1965), has signs listed according to their forms, and then specified for their use in sentences. Thus there is a single sign form listed as a verb meaning 'to sit' as well as a noun meaning 'chair'; another sign form is listed as a verb meaning 'to bicycle'; as well as a noun meaning 'bicycle,' and so on for a vast number of signs. The implication was that, like the English word drink which is used both as a noun and a verb, the same sign form in ASL is used in both nominal and predicate contexts. And this also was the received view for many years of our own studies. However, starting late in life to become attuned to movement distinctions that might differentiate meanings in a visual-spatial language, we finally began to see a difference in the way a sign was made depending on its use as a noun or verb in a sentence. The first impression was that a noun form sometimes seemed "smaller" than the related verb form. Ted Supalla (a native ASL signer who was then a researcher in our laboratory) investigated pairs of noun/verb signs (listed as single forms in the Dictionary of American Sign Language) and found systematic differences between them. His important study with Elissa Newport formed the basis for a new understanding of the layer of grammatical processes in ASL, the kinds of movement feature distinctions required, and the kinds of rules that relate surface forms and abstract underlying roots (Supalla and Newport), 1978.

Thus, ASL signs (once thought to be single sign forms used in different contexts, much as words in an isolating language like Chinese are used without morphological markings for grammatical category) turn out to be split apart into whole paradigms of differentiated sign forms. The forms all share the same handshape, the same place of articulation, and the same movement shape (e.g., circular, directional, wrist twist, nod, etc.), but are differentiated from one another by other features of movement: features such as frequency, end manner, rate, tension, displacement, etc. (Klima and Bellugi, 1979). Verbs and their formationally related nouns are distinguished from one another in part by a manner differentiation: verbs end in hold or continuous manner; nouns have restrained manner of articulation. Thus there is a consistent differentiation in citation form between what is glossed as SIT-DOWN and CHAIR; RIDE-BICYCLE and BICYCLE; TELL-STORY and STORY; TO-TYPE and TYPEWRITER (see Figure 5a), and countless others. These forms would have separate listings in an expanded dictionary of ASL. Consider the pair BICYCLE

and RIDE-BICYCLE in Figure 5a: /S/ hands circling repeatedly in alternation. The noun is differentiated from the verb only in that it has restrained manner (one can sense it in the articulation) and the resulting sign form is seen as smaller. That accounts for what we had noticed on our videotapes, as Supalla explained: the visible effect is smaller movement, but the motivating feature is an articulatory one--a slight tensing of the muscles. These featural differences mark pairs of forms throughout the language and are freely extended to nonce signs, and recently invented signs. Thus, the morphological marker distinguishing nouns from verbs is used productively in the language. The marking is subtle, at least to the eye of some non-native signers, but now that our eyes have been more finely tuned to the movement features that mark morphological distinctions in ASL, it is evident that the formal markers differentiating nouns and verbs were there right along.

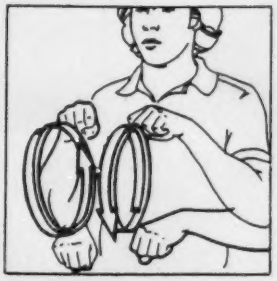
-----Figure 5 here-----

The prototypical cases of such noun/verb distinctions in the language are concrete nouns and associated action verbs. Not surprisingly, many of these have an iconic basis: verbs in these pairs have an image base of action of the hands on or with an object (e.g., TO-TYPE and TYPEWRITER). However, such distinctions in the language are not restricted to concrete nouns and associated activity verbs (e.g.,DERIVE/DERIVATION, MODULATE/MODULATION; SEARCH/EXAMINATION; GET/ACQUISITION; ANALYZE/ANALYSIS); and the image basis for a pair is often obscured. Still, the directness of representation might influence the course of acquisition. In terms of the form of the morphological markers themselves, one could argue that the verb markers are motivated, and the noun marker is not. There is some relation between aspectual meaning and formal marking for verbs: in general, single movement in the verb signs correspond to single, punctual, or perfective action. Repeated movements in verbs refer to durative or iterative activity, made of repeated punctual actions (see Supalla and Newport, 1978 for futher discussion). The noun marker is always repeated, restrained, small; not an obvious formal marker for static objects! Futhermore, the noun marker often diminishes the iconicity of the image base, in that the sign movement no longer resembles the action. (We have noted that in general, grammatical processes in the adult language operate without reference to any iconic properties of the signs themselves; see Klima and Bellugi, chapter 1, 1979.) Thus, the verb OPEN-BOOK has an image base of hands opening a book (single movement). The noun sign BOOK has a restrained repeated movement that seems quite unrelated to what one would do with a book, thus obscuring its image base.

In 1982, only four years after the first description of the distinction between nouns and verbs, Patricia Launer, in our laboratory, has completed a thesis on the acquisition of this derivational process in deaf children of deaf parents (Launer, 1982).

SIT-DOWN

CHAIR



RIDE-BICYCLE

BICYCLE

TELL-STORY

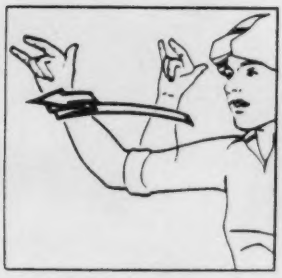
STORY

TO-TYPE

TYPEWRITER

5a) Derivationally-related Noun-Verb Pairs in ASL.

AIRPLANE (noun)



AIRPLANE
('stage' signing)

*AIRPLANE
('Motherese')

5b. ASL Noun, AIRPLANE, in Normal Signing, Enlarged 'Stage' Signing, and the 'Motherese' Form which is Neither a Verb nor a Noun.

Launer has amassed a formidable array of data on the acquisition of these morphological distinctions in ASL, from free signing on videotapes and a series of elicitation tasks which she developed and first tested with deaf adults. She took seriously the description provided by Supalla and Newport, developed a feature system for encoding the morphological distinctions (e.g., restrained, small, repeated for nouns, etc.) and noted the form of every noun and verb pair--detailed descriptions of manner, size, repetition and other features--in the signing of deaf children and their deaf mothers through several years of data. Using the data produced by the elicitation tasks (32 deaf children of deaf parents across an age span of 2;0 to 11;0) and her analysis of transcripts of monthly videotapes of mother-child spontaneous interaction in three deaf children spanning the range from 0;9 to 6;0, Launer found consistent periods in the acquisition of derivationally related pairs of nouns and verbs. She found that the children's productions (and also the mothers' signing to children) changed systematically over time. Launer identified the following steps toward acquisition of the formal relations between noun and verb forms.

Period	Age	
1	1-2	Children are simply acquiring lexical items but not morphologically marking related noun and verb forms.
2	2-3	Children sporadically mark nouns and verbs with appropriate features, but do not do so systematically, often providing noncanonical or idiosyncratic markings.
3	3-5	Children now mark full morphological distinctions between nouns and verbs quite systematically, and go on to make overextensions of the formal markings to unpaired forms and to lexical innovations.

Period 1: Before the age of two, the children's signs do not include the morphological markings that distinguish related nouns and verbs (across 80% of cases); children at this early period are in fact primarily learning the parameters of root forms and are not yet distinguishing morphologically related forms. More surprising was Launer's finding that the mothers uniformly and consistently obliterated the distinctions she was seeking so valiantly to classify; but only when signing to children under two, not to older children. For example, a deaf mother was with her two children, ages one and three. To the older child, she signed "PLEASE YOU GET HER BOOK," making the noun form canonically--with small restrained duplicated movement. Then she handed the book to the younger child and signed

"THAT *BOOK" (That's a book'), with large continuous repeated movement, without any of the featural properties that mark the noun. Mothers' productions would tend to exaggerate sign size, and repeat the sign form many times, but in the process sometimes produce forms with dynamic characteristics not found in ASL signs and without the required derivational distinctions. (Both mothers' and childrens' productions were judged ungrammatical by deaf adults.) Was this because the mothers surmised that their young children, like older non-native signers, might not be ready for the distinction? We cannot be sure; certainly it is not the case that enlarging a sign form extinguishes its morphological marking automatically, since in signing from a stage or across distances, there is a general enlargement of signs, but with preservation of morphological markers. Figure 5b shows the noun sign AIRPLANE, an enlarged 'stage' version of the noun form, and an example of a 'noun' form used by mothers to Period 1 children. The 'motherese' is neither noun nor verb, nor is it a possible adult form; rather, it is a distortion which obliterates morphological markings.

In mother-to-child signing at this early period, we also found occasional mimetic elaborations of signs, signing on the children's bodies, or molding the children's hands. Mothers sometimes elaborated the image basis of signs to these very young children (only 8% of the signs in a sample were so elaborated, but about 20% of the formationally related noun-verb pairs were). For example, the sign DUCK which has an image base of the opening and closing of the beak of a duck was signed to a child under two with an enlarged opening and closing movement going toward the child and ending in a playful gentle "bite" on the child. After age two, the mother-to-child signing changes dramatically; sequences are longer, mimetic elaboration and exaggerated repetition drops out, and mothers now provide the morphological features that mark the distinctions between noun and verb forms in the adult language. Thus during this first period of lexical acquisition, children do not formally distinguish ASL nouns and verbs.

Period 2: The children sporadically mark nouns and verbs with the appropriate set of feature markings, but they do not do so systematically (only 20% of the time are the full distinctions present). In general, during this period, children are learning the privileges of occurrence of nouns and verbs and their syntactic use in sentences, but they have not yet mastered the systematic movement features that differentiate them in the adult language. There are many instances of related nouns and verbs used in the same or in consecutive utterances, but most do not have the full morphological markers. Nearly half the time, children provide other distinctions between nouns and verbs that are not part of the movement featural markers; for example, changing the movement direction, speed, or shape of one of the members, or adding facial or bodily distinguishers. These are what Launer has termed non-canonical distinctions.

Sometimes these are idiosyncratic, as when a child signed KEY with unidirectional movement and the related verb form LOCK with bidirectional movement. Thus, before the morphological distinctions (marked by layered features of movement) are consistently used by the children, they sometimes use redundant or even idiosyncratic markings to distinguish a noun from a verb, as though there is a growing awareness of the distinction in ASL, but they have not yet mastered the appropriate featural markers.

Period 3: Launer found that deaf children between three and four years of age were providing the morphological markers quite consistently, and even, by the following year, extending them to new forms. At this period, the markers were applied across the board to signs, regardless of their mimetic or iconic bases, regardless of whether they represented concrete objects and activities or whether they represented more abstract nouns and verbs. Iconicity thus has neither a facilitative nor hindering effect on the generalization of a morphological process. Figure 6a shows the child signing the noun DOOR and the verb OPEN-DOOR with the appropriate morphological markings. Cases with no distinctions have virtually disappeared and most nouns and verbs are marked with full or partial featural distinctions (70%).

-----Figure 6 here-----

The children during this period begin marking nouns and related verbs differentially in earnest in the same way as adults do in citation form. Now there are even related sentences in which both members of the pair occur with full marking. For instance, one child, 3;4, was signing about plans for a trip to see her grandmother. "LATER HAVE AIRPLANE, WILL FLY," she signed ('We will have an airplane and fly in it.'). Another child of 3;6 invented a story in which she had an imaginary car that she didn't want to drive. 'Here's the key,' she signed to her mother, handing her an imaginary key: "YOU DRIVE MY CAR" (see Figure 6b). The child used the single root of DRIVE and CAR but differentiated the two forms by their full morphological markers. These three-year-old children then, were systematically distinguishing noun and verb forms within a single sentence.

The most striking evidence that children have analyzed out morphological marking from across sign forms differentiating noun and verb classes is that they extended these markings to new instances in a variety of ways:

Nouns	Verbs
CLOTHESPIN (3;11)	BUILD-HOUSE (3;2)
TYPEWRITER-KEYS (4;4)	PUSH-WHEELBARROW (3;7)
LAMB (4;4)	LIGHTER-ON (3;8)
JAIL (4;9)	TO-PICNIC (4;4)

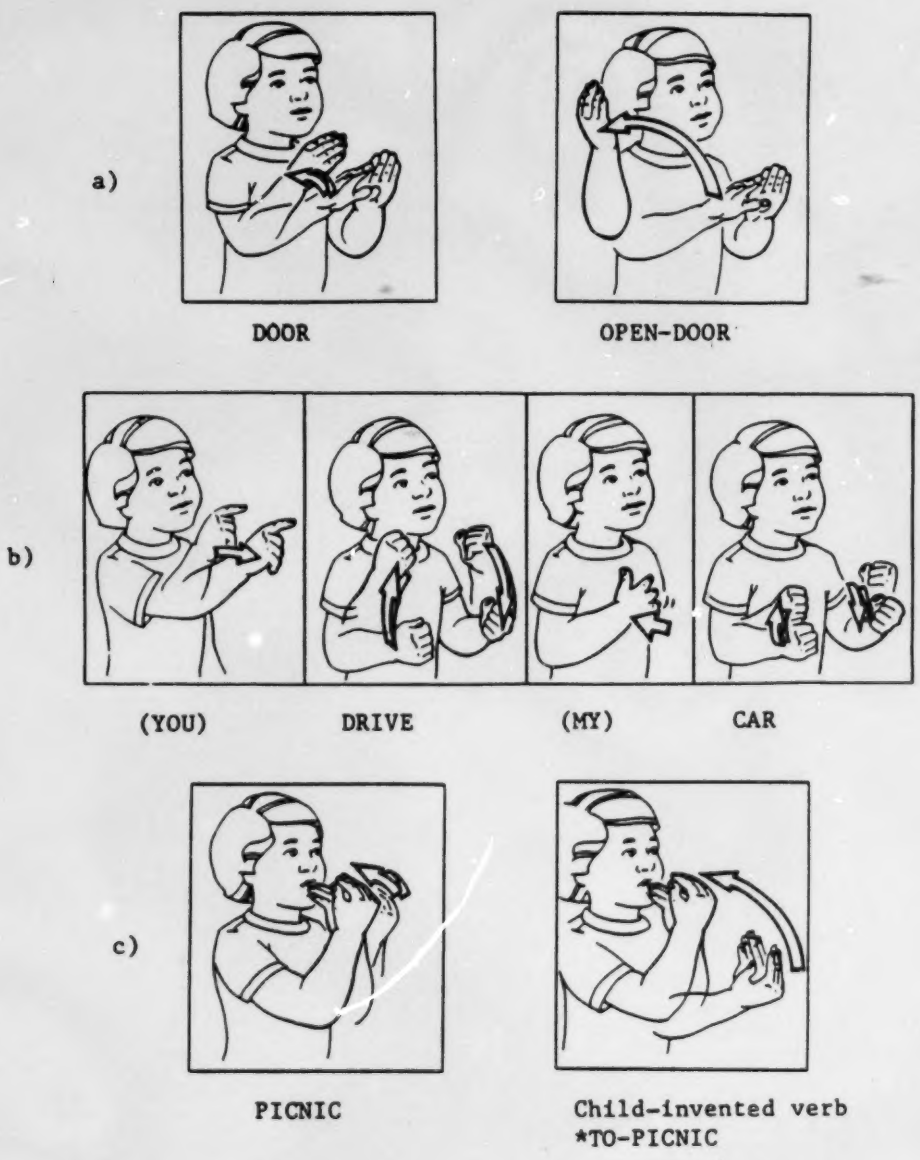


Figure 6. Derivational Relationship Between Noun and Verb. Child's Correct Instances (a and b) and Over-extension (c).

Some children invented signs and provided the appropriate morphological markers, as in invented signs for LAMB, TYPEWRITER-KEYS, BUILD-HOUSE. Some children extended forms in the language to invent partners or to regularize exceptions. One child extended the ASL noun sign PICNIC which does not have a related verb, and using an appropriate verb marker, signed something like 'to picnic' (see Figure 6c). Another child was complaining about her mother's control of her activities, and signed the equivalent of "Home is like a jail. I can't open the door, I can't go out. I'm put-in-jail," using the single movement form for the verb. The adult ASL noun and verb form JAIL/PUT-IN-JAIL are identical, the distinction perhaps having been neutralized. However, in the child's signing, the two instances of JAIL (one a verb and one a noun) were marked differentially. The verb conformed to adult usage; however, the child unexpectedly provided the canonical marker (restrained manner, small size, repeated movement) for the noun as an over-regularization.

One child invented her own mimetically-based form CLOTHESPIN, with an image base of pinning something on a clothesline. An imitation of the mimed act would have a single closing and release of the clothespin as it is attached to the line. The child's form instead had the non-mimetic (repeated, restrained, small) movement characteristic of nouns. Thus, even here in an invented sign where the mimetic aspects of the movement of a form might be expected to prevail, those aspects give way to the non-mimetic: the child extends the morphological markers across all forms.

We have examined here three of the first morphological systems of ASL to be mastered by the signing child. Because of the transparency of forms, we surmised that these would be systems where one might expect a profound influence of iconicity. What we found, however, was that the transparency at all levels appears to have little or no effect, and that the deaf child systematically analyzes out discrete morphological components of the system presented to him in an ordered and orderly fashion. The evidence suggests that the course of acquisition of ASL is startingly like that of spoken languages of a similar structural type. In details of timing and the nature of errors rather more like the acquisition of Hebrew than Turkish (Slobin and Aksu, 1980; Berman, 1982 and personal communication). In ASL, morphological markers are not affixal, are nonsegmental, and nonstressable; moreover they are simultaneously organized with the sign root. The fact that the articulators in sign language are visible and manipulable could provide a special route to learning: mothers, in fact, mold and shape young children's signing. Our evidence shows that this too is steadfastly and systematically ignored by the signing child who firmly holds his ground and stays with his incorrect analysis until he himself arrives at a re-organization of his language system.

III. <u>The Integration of Systems: Spatially Organized Discourse</u>

Above we show that despite the difference in modality, the course of acquisition is remarkably like that of various spoken languages. There is, however, one area where the mastery of the system appears to come at a surprisingly late period--surprising in that it involves aspects of pronominal reference and the verb agreement system, but also involves the integration of these into a spatially organized referential framework for syntax and discourse. In the future, the study of the development of the mechanisms underlying such functions in deaf children may give us a powerful new tool for investigating the organization of discourse in languages in general.

Languages have different ways of marking grammatical relations among their lexical items. In English, such relations are signaled largely by the order of items; in other languages these relations are signaled by case marking or verb agreement morphology. All of these rely at some level, on linear ordering of words or segments. By contrast, in a visual-spatial language like American Sign Language, relations among signs are stipulated primarily by manipulation of points in space. A horizontal plane in front of the signer's torso plays an important role in the structure of the language; nominals introduced into the discourse are associated with specific points in the plane of signing space. Pointing to a specific locus later in the discourse clearly 'refers back' to a specific nominal, even after many intervening signs. Indexible verbs are obligatorily marked for person (and number) via such spatial indices, which specify subjects and objects of the verb. Coreferential nominals must be indexed to the same locus point to maintain identity (Bellugi and Klima, 1982; Padden, 1982). Thus, the same signs, in the same order, but with a change in direction of movement of the verb indicate different grammatical relationships. Furthermore, meaning can be preserved under a different temporal order, since relationships are specified spatially. The system of spatial indexing permits relative freedom of word order (in simple sentences, anyway) and yet provides a clear specification of grammatical relations by spatial means. The use of space in these different systems (pronominal reference, nominal establishment, verb agreement, maintaining identity of loci, spatial contexts) is complex and dynamic. In each subsystem there is a mediation between the visual-spatial mode in which the language has developed and the overlaid grammatical constraints in the language. Thus the syntax and discourse of American Sign Language relies heavily on manipulation of abstract points in space, and of spatial representation. This difference in surface form of grammatical mechanisms could have important consequences for the acquisition of sign language.

In our laboratory, Ruth Loew has begun a study of deaf children's spontaneous narratives, examining the acquisition of the systems underlying anaphoric reference (Loew, 1982). We find the following stages in acquisition in the signing child:

At age 3;1, the child's storytelling is extremely difficult to understand, due in large part to unclear reference. Signs follow one after another with no use of space and no syntactic indicator of which characters performed which actions. Verbs are rarely indexed for nonpresent reference and if they are, it is without explicitly associating nominals with the indices. It is important to note that, as we described above, the same verbs are consistently and correctly indexed for present reference at this age. Thus, it is clear that the two systems (verb agreement and establishment of nominals) are functionally separate systems for the child. At this age, the child's formal mechanisms for conveying anaphoric reference beyond present contexts are minimal. The child converses freely of matters outside the here and now, and has no problems conceptualizing them; her problems clearly lie in conveying explicit information about them according to the spatialized grammatical mechanisms provided by the language.

At 3;6, the child begins to make use of indexing in storytelling; however, she does not explicitly establish identities for loci. Furthermore, she tends to use one locus for several referents, stacking them up at one locus point, thus still leaving reference unclear and ambiguous (see Figure 7a) (Petitto, 1980, describes another child's first use of abstract spatial loci, in which he 'stacked' 11 characters in one location!)

-----Figure 7 here-----

At 4;4, the child uses several different loci in a single story, but still does not generally establish identities for loci, nor does she maintain a referent-to-locus mapping. She seems to mark shifts in character spatially, but does not maintain identities, and she distributes loci randomly.

By 4;9, the child has increased use of indexing and begins to have consistent use of a designated locus for a referent. Her storytelling is qualitatively different from earlier stages and is much more adult-like; the use of space is frequently incorrect, but by this age it is pervasive. The child has begun to integrate various aspects of spatial reference and addressee interaction; loci are now often formally established and consistently used. The child attends closely to the addressee at role transitions, and makes frequent self-corrections at such boundaries, suggesting that she is aware of the possibilities of confusion at these points. See Figure 7b for a particularly complex example in which the child was recounting an imaginary story in which she (Jane) had ten children, and another woman arrived to claim them as her own. Jane (in the role of the other woman) signed: "I WANT MY....YOUR....JANE'S CHILDREN." One can understand why she finally resorted to the use of her own name sign to clear up reference in this situation!

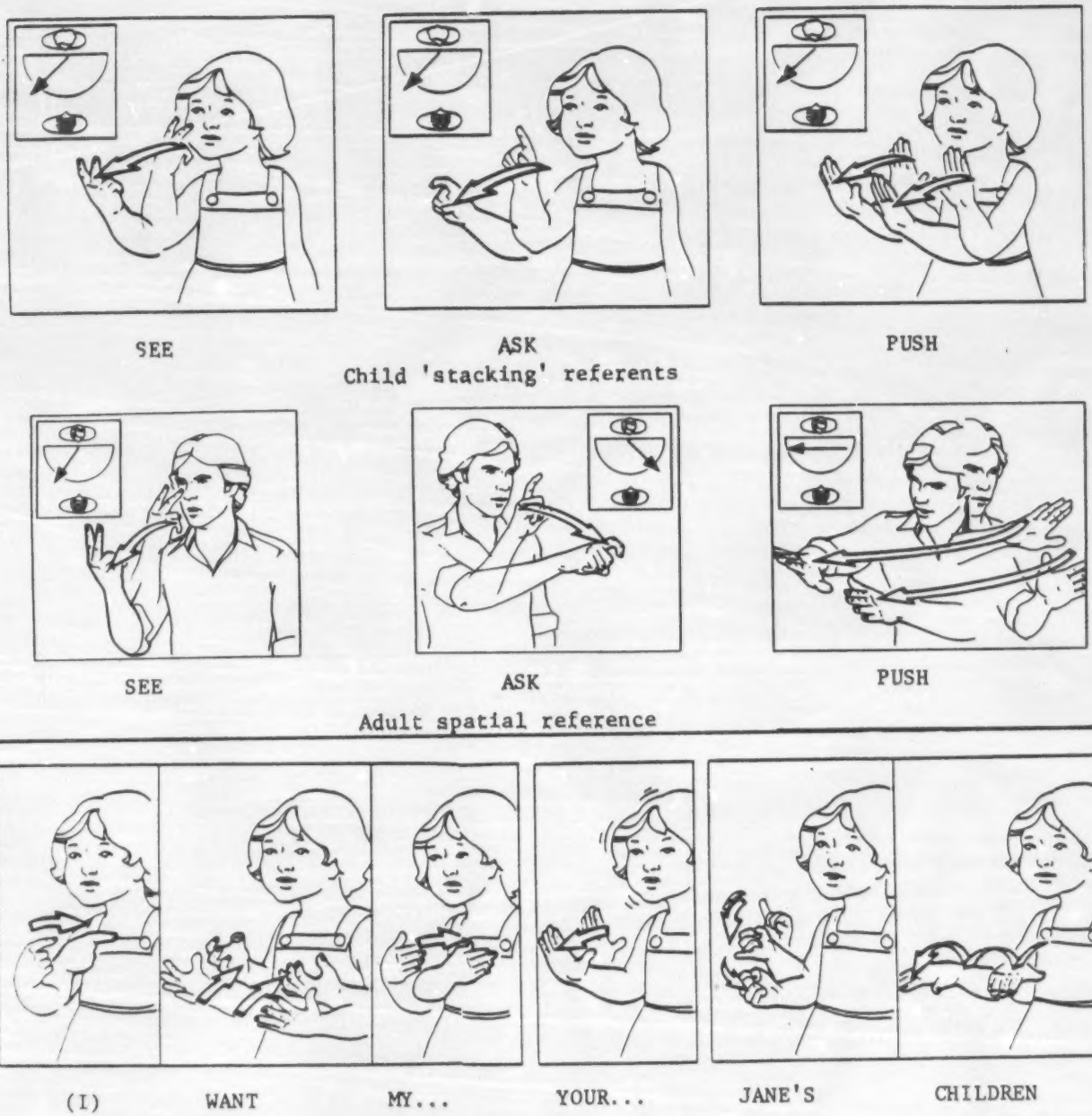


Figure 7. The Acquisition of Spatial Indexing.

Analysis of the nature of the child's errors thus clarifies the multi-leveled character of the reference system. Spatial reference must be used consistently to identify as well as to contrast referents. The child's errors seem to occur at the interfaces of the system, and thus draw attention to these interfaces. The study of the acquisition process therefore heightens our understanding of the adult language system.

In this section, we considered the acquisition of a domain in which the nature of the apparatus used in ASL may have its most striking effect: the means by which relations among signs are stipulated in sentences and in discourse. In a spoken language like English, the intended reference of lexical pronouns in children (and sometimes in adults as well) is often unclear. The spatial mechanisms used in ASL, by contrast, require that identity of referents be maintained across arbitrary points in space which are not lexical units. In English, this is a matter of lack of clarity; in ASL, the failure to maintain identity results in strings which are ill-formed, i.e., judged ungrammatical. Thus, what is required by the grammatical system evolved in this visual-spatial language lays bare the problems the child has in organizing coherent and cohesive discourse.

IV. Summary

The study of language acquisition in deaf children brings into sharp focus some of our most fundamental questions about the human linguistic capacity. In our own research over the past decade, we have been specifying the ways in which the formal properties of languages are shaped by their modalities of expression, sifting properties peculair to a particular language mode from more general properties common to all languages, and thus reflective of biological determinants of linguistic form. We have described similarities in principles of organization between spoken and sign language. However, our studies show also that at all structural levels, the surface forms of a sign language are deeply influenced by the modality in which it develops: in the co-occurring layers of lexical, derivational, and inflectional structure, and in the pervasive use of spatially-organized syntax. In sign language we can clearly observe the child's acquisition of the spatial mechanisms of the language, and the separable structural systems they embody, and these observations can give us a unique viewpoint on the acquisitional process across modalities. The specific requirements posed by ASL syntactic spatial mechanisms, for instance, may illuminate problems all children have, hearing or deaf, with maintaining topic and subjects across discourse.

In this paper, we have examined three of the first morphological systems to emerge and be mastered by deaf children--and how these subsystems are integrated into mechanisms for organizing syntax and discourse. In general, it appears that despite the radical differences in modality of language, deaf and hearing children show a dramatically similar course of development, given a natural language input at the critical time. The deaf child, as does his hearing counterpart, analyzes out discrete components of the system presented to him. Furthermore, the evidence suggests that even when the modality and the language offer possibilities that seem intuitively obvious (pointing for deicitic pronominal reference, for example), the deaf child appears to ignore their directness. The comparison of signed and spoken languages will surely become a priviledged testing ground for examining iconic, semantic, cognitive, and formal linguistic influences on the course of the acquisition process.

* * * * *

What can we conclude from looking at the acquisition of the morphological systems considered here? The data show powerfully how language, independent of its transmission mechanisms, emerges in the child in a rapid, patterned, and--above all--linguistically-driven manner.

Acknowledgements

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We are grateful to the deaf children and parents who have taken part in our longitudinal studies of the acquisition of sign language, from the onset of first gestures to the mastery of the spatially-organized syntax; we are also grateful to the children, teachers, and staff of the California School for the Deaf, Fremont, California for their spirited participation in these studies, which provide new perspectives on the human capacity for language.

Footnotes

1. We use the following notation in this paper:

SIGN	Words in capital letters represent English labels (glosses) for ASL signs. The gloss represents the meaning of the unmarked, uninflected, unmodulated, form of a sign out of context.
SIGN-SIGN	Multiword glosses connected by hyphens are used where more than one English word is required to translate a a single sign (LOOK-AT).
'meaning'	Words within single quotation marks indicate the meaning or referent of the words or signs; e.g. 'tree' indicates the referent tree, not the English word tree.
SIGN[X:]	A form that has undergone indexical change. The form or meaning may be specified, as in INFORM[X:1 to 2] or INFORM[X:'I to you'].
SIGN[N;M]	A form that has undergone inflection for numerosity (number and distributional aspect), or for temporal aspect, focus, or degree.
SIGN[D:]	A form that has undergone a derivational process.
*SIGN	An asterisk preceeding a sign form indicates that it is ungrammatical within adult ASL.

2. Our studies suggest that, in the signal, the layers of structure are separable, perhaps even composed of different structural components (Bellugi, 1980). For example, deaf signers are highly accurate at recognizing and identifying morphological operations presented in point-light displays, suggesting that these patterns of dynamic contours of movement form a distinct isolable (but co-occurring) layer of structure (Poizner, Bellugi, and Lutes-Driscoll, 1981).

3. Children's ages are noted in terms of digits referring to year and month (e.g., 2;11).

4. Meier studied only the acquisition of verb agreement with spatial loci of referents which are present within the context of the conversation. Verb agreement with arbitrary spatial loci that have been associated with nominals introduced into the discourse context requires integration of several subsystems, and is discussed in Section III.

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